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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:			
	RODNEY M. LAFOLLETTE, ET AL.	Docket:	7310.C
Serial No.:	09/930,539	Art Unit:	1745
Filed:	August 14, 2001	Examiner:	RAYMOND ALEJANDRO
For:	MICROSCOPIC BATTERIES FOR MEMS SYSTEMS		

OCTOBER 2004 DECLARATION OF RODNEY M. LAFOLLETTE, Ph.D.

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on October 11, 2004.

Lynn G. Foster

Sir:

I, Rodney M. LaFollette, declare and state as follows:

BACKGROUND

1. I am a citizen of the United States of America and a resident of the State of Utah.

2. I hold a Doctorate in Chemical Engineering from the Brigham Young University.

3. My education and professional curriculum vitae is attached as Exhibit "A."

4. I have many years of business and educational experience. This includes extensive experience in the electric battery field. I am one of only a few foremost experts in sophisticated extreme miniature battery technology.

5. I am an inventor, either sole or joint, of several inventions comprising the subject matter of U.S. patent applications and issued U.S. patents. I am a co-inventor of the invention of the above-identified patent application.

6. I have worked extensively in research and development pertaining to electric batteries and an thoroughly familiar with various electric battery, capacitor and fuel cell developments.

7. The present invention, compared to prior art, is a major break through and comprises, in respect to the prior art, the only technology by which a battery may be prepared in integration with a MEMS as an internal long term source of electrical power for the MEMS. It is impossible for the prior art relied upon to be small enough to be integrated with a MEMS or other microscopic circuit having an equivalent size as a source of electrical energy.

8. The present invention is orders of magnitude more patentably and commercially significant than the invention of the Bates patent U.S. 5,455,126 ('126), which was allowed on the first action at minimal expense to Bates, unlike the present invention. See Exhibit "E."

THE PATENT PROSECUTION

9. Because of inexplicable prejudice and a technical vacuum demonstrated on the part of the U.S. Patent Office (USPO), six years of prosecution where the USPTO has constantly changed positions in respect to 35 U.S.C. § 112 and on the prior art, I and the assignee company, Bipolar technologies, Inc., which I own, have incurred patent costs between $100,000.00 and $200,000.00 in an on going effort to gain valuable patent protection, which is clearly merited. I have personally devoted between $50,000.00 and $75,000.00 of my time on patent prosecution. The financial and time burden have placed me and the assignee on the verge of insolvency. I have no idea why this and companion applications have been singled out for such partial and inappropriate treatment of a pioneer invention, which solved a previously unsolved long standing problem pertaining to the inability to provide internal power to MEMS circuits.

10. I am bewildered at the shifting between negative positions by the USPO collectively in the parent application (Serial No. 09/037,801) and in this application (see summaries attached as Exhibits "F" and "G"), some of which are identified below:

a. A twenty three way restriction was reduced to a five way restriction pursuant to a petition in the parent application, leaving parent Claims 10-43, 51-54, 89-92, 94-97 and 103-109 as elected claims pertaining to a single invention. Exh. "J" and "K."

b. All of the elected claims of the parent were first rejected under § 103(a) on Hockaday 5,759,712 in view of Hockaday 5,631,099. These references were overcome and determined to be irrelevant only at great expense, effort and delay, resulting in the two Hockaday references being entirely discarded.

c. Next, the elected claims in the parent application were rejected on Arledge U.S. 5,437,941 under § 103(a). Ignoring several Declaration from Ph.D. experts and an Amendment on October 20, 2000, the USPO repeated the Arledge rejection and made the rejection final and refused further prosecution, forcing the Applicants to file the present continuation application, which is limited to the elected claims only of the parent.

d. Even a CPA proved futile, as the Arledge rejection was maintained. See Exhibit "I."

e. Inexplicably, in the present application the USPO inconsistently determined that only claims 21-40 in this application pertained to a single invention and claims 10-20, 41-43, 51-54, 89-92, 94-97 and 103-109, part of the elected invention in the parent, were no longer part of a single invention.

f. The Arledge reference, which the USPO asserted in the final Office Action in the parent, was discarded in this application in favor of two new references, relied upon for the first time. So $150,000.00 and six years after filing, we start over, but with few claims. Elected claims 21-31, 33-36 and 38-40 were erroneously rejected

for the first time under § 102(b) on Bates '126 and claims 26-28, 32 and 37 were erroneously rejected for the first time under § 103(a) on Bates '126 in view of Miekka '942.

11. How truly valuable it would have been to the Assignee to have had an objective examination of the parent and this continuation application, as did Bates, a much less significant invention. The prosecutional history of Bates is attached as Exhibit "E."

APPLICANTS' PROBLEM

12. The long term problem solved by the present invention is well identified in a 1998 newspaper article, copy attached as Exhibit "B," which concerns co-inventor Linton Salmon, Ph.D.. Dr. Salmon is a MEMS expert.

13. The problem addressed is also identified in the present application, the specification of which is identical to U.S. Patent 6,610,440 ('440), copy attached as Exhibit "C." See, for example, Column 1, lines 59-62, Column 2, lines 60-64, Column 5, lines 39-54 and Column 8, lines 65-66 of Exhibit "C."

14. Neither Bates '440 nor Miekka U.S. Patent 6,045,942 ('942) address Applicants' problem nor can their technologies, taken alone or together, provide Applicants' solution, i.e. a microbattery small enough and powerful enough to be integrated with and power a MEMS.

DECLARANT'S UNDERTAKING

15. I have been requested to provide an assessment of the 35 U.S.C. § 112 position of the USPO and of the claimed subject matter of the above-identified application in comparison with Bates '440 and Miekka '942, relied upon by the Examiner in this application, to provide testimony concerning the prior art and to identify the patentable differences between the prior art relied upon and the claimed invention. A copy of the Office Action is attached as Exhibit "D,"

which lacks objectivity and demonstrates a lack of technical mastery of both the prior art and the present invention.

16. I consider my skill in the electric battery field to be above ordinary skill. If the claimed invention is not obvious to me, based upon the applied prior art, it would not be obvious to one of ordinary skill.

17. In the course of functioning as indicated above, I received and reviewed a copy of the above-identified application, as filed.

18. I also received and analyzed a copy of the Exhibit "D" Office Action in the above-identified application mailed August 5, 2004, a copy of Bates '440 and Miekka '942 relied upon by the Examiner in said Office Action, and a copy of the Amendment being filed essentially contemporaneously with this Declaration.

19. I was asked to evaluate the 35 U.S.C. § 112 first paragraph rejection, the 35 U.S.C. § 102(b) and the 35 U.S.C. § 103(a) rejections contained within the Exhibit "D" Office Action.

20. I am familiar with the invention of the above-mentioned application, as originally filed, and the claims as originally filed and as presently constituted, due to the above-mentioned contemporaneous Amendment, because I have studies both. I have also read and studied the two patents relied upon in the said Office Action.

21. In the Office Action mailed August 5, 2004 (Exhibit "D"), the USPO makes the following objections and rejections:

a. The USPO objected as follows:

> Claims 23 recites the limitation "the thin electrode layers" in line 2. There is insufficient antecedent basis for this limitation in the claim.
> Claim 33 recites the limitation "the etched microfabricated electrodes" in line 8. There is insufficient antecedent basis for this limitation in the claim.

b. The USPO made the following 35 U.S.C. § 112, second paragraph, rejection:

Claims 21-40 are rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.
The term "internal only etched spaced electrodes" in claim 21 and "of internal reactants only in the nature of separated internal microfabricated electrodes" in claim 33 is unclear and ambiguous, thereby rendering the claims indefinite. Further, the foregoing language is not defined by the claim, and the specification does not provide a standard for ascertaining the requisite degree. It is unclear as to what is particularly meant by the "internal only" limitation and its implication with respect to the final battery structure. Further clarification is required.

c. The USPO made the following 35 U.S.C. § 102(b) rejection:

Claims 21-33, 33-36 and 38-40 are rejected under 35 U.S.C. § 102(b) as being anticipated by Bates et al. 5,455,126.

d. The USPO made the following 35 U.S.C. § 103(a) rejection:

Claims 26-28, 32 and 37 are rejected...under 35 U.S.C. § 103(a) as being unpatentable over Bates et al. 5,455,126 as applied to claim 30 above, and further in view of Miekka et al. 6,045,942.

22. In its § 102 (b) rejection, the USPO erroneously contends:

a. The instant claims are directed to a microfabricated battery wherein the disclosed inventive concept is the micro-nature of the battery. [To the contrary, the present invention is directed to a microfabricated (deposition and removal of material) battery, which can satisfy the power requirements of and be integrated with a MEMS as an internal source of electrical power.]

b. Bates et al....is a microfabricated battery.

c. [The Bates] micro-battery provides spaced electrodes containing electrode reaction accommodating electrolyte between the electrodes.

d. [T]he [Bates] electrodes are etched.

e. The USPO wrongfully ignores a key inventive claim limitation that the claimed battery must be integratable with a MEMS:

> **Examiner's note:** as to the limitations: a) "adapted for direct and congruent size integrating with microelectrochemical systems and/or microcircuitry to reduce power losses", or b) "for direct size and electronic integrating into a microelectrochemical system or non-microelectrochemical system microcicuit to alleviate power losses", it is contended that this limitation does not distinguish over prior art because the recitation that an element/feature/member is "adapted to (for)" perform(ing) a function is not a positive limitation but only requires the ability to so perform.

f. The USPO engaged in further hindsight reconstruction:

> [T]his [Bates'] batteries (sic) stand for flat cells as well as having the battery fabricated onto the semiconductor chip implies having the battery attached thereto (peg in a block). In addition, battery geometries including: the flat cell, spirally wound, bipolar and linear; and wire-shaped, odd-shaped; wire in a can; peg in a block encompasses a very large number of possible permutations of battery configurations.
>
> [I]t is noted that any of these fabrication techniques is capable of producing a patterned or designed material by eating into the material surface as required by action of etching. [Bates doesn't remove material to create a pattern.]

23. In the § 103(a) rejection, the USPO makes clearly erroneous and hindsight based technical assertions:

> a. [I]t would have been obvious to one skilled in the art at the time the invention was made to use the specific liquid electrolyte material and the specific electrolyte influent flow path of Miekka et al. in the thin-film battery of Bates et al. as Miekka et al. teaches that the specific aqueous electrolyte is chosen based on the overall chemistry required by the battery and which cooperatively participates to produce the desired electrochemical reaction.
>
> b. [I]t would have been obvious to one skilled in the art at the time the invention was made to use the specific electrode materials of Miekka et al. in the thin-film battery of Bates et al. as Miekka et al. teaches that it would be readily appreciated

that the active electrode material are such materials or combinations thereof which cooperatively participate to produce the desired electrochemical reaction, wherein the cathode electrode includes a material which acts in the overall system as an oxidizing agent and the anode electrode includes an active material that is easily oxide and thus functions as an available source of electrons, and thus, the claimed electrode materials exhibit the afore-mentioned properties.

c. As to the specific battery geometry, it would have been obvious to one skilled in the art at the time the invention was made to use the specific battery geometry of Miekka et al. in the thin-film battery of Bates et al. as Miekka et al. teaches that the anode to cathode electrode geometry may take one of many forms for ease manufacturing. Thus, Miekka et al. envision varied battery geometry so as to improve manufacturing thereof.

d. It is noted that Bates et al. and Miekka et al. are pertinent to each other as well as to applicant's invention as they both share the same field of endeavor of providing working functional thin-film microsized batteries.

24. In reaching the misplaced conclusions and making the technically erroneous assertions contained in the above-mentioned Office Action, the Examiner attempted to make himself a fact and an expert witness, engaged in hindsight reliance based upon access to the above-identified application, drew erroneous technical conclusions and made rejections inconsistent with the clear disclosure in the present specification and teachings of the prior art relied upon. See the detailed testimony provided below.

25. As to the objection, the claims have been amended to cure the lack of antecedence.

26. As to the § 112, second paragraph, rejection:

a. batteries are inherently limited to "internal only chemical reactants", whereas fuel cells move the reactants into and out of the cell.

b. "internal only etched spaced electrodes" are disclosed. There is no external etching. The electrodes are internal of the battery and etching of the electrode

therefore is internal, not external. [To make the examination process more efficient, the Applicants have removed the language of concern.]

THE CLAIMED INVENTION HAS BEEN FOUND PATENTABLE OVER BATES

27. In terms of clear non-anticipated, nonobvious invention, the best starting point is the Claim of U.S. Patent 6,610,440 ('440), found allowable over Bates '126, which is reproduced below:

> 1. A microfabricated battery comprising a pair of microscopic electrodes, a microscopic amount of electrolyte disposed in a microscopic site between the electrodes, the microfabricated battery comprising an area as small as one square micron.

Thus, the '440 patent is a prior admissible by the USPO that the microfabricated battery of the present invention which for the first time can be made as small as one square micron, so as to be integratable with a MEMS, embraces non-anticipated, nonobvious patentable subject matter, equally applicable to the allowance of the presently pending elected claims of this application.

ANALYSIS OF PRIOR ART

ANALYSIS OF BATES

28. Bates (5,455,126) is not enabling because it admits to a disclosure need for Figures 1, 2A-2D, 3, 4A, 4B and 5, but the 5,455,126 ('126) patent comprises no drawings at all. However, the 5,455,126 Bates Patent is a division of U.S. 5,338,625 ('625), which does include the Figures. For ease of reference, the '625 patent (copy attached as Exhibit "H") is analyzed below as if it were the '126 patent.

29. Bates characterizes his invention as being a "thin-film battery" Column 2, line 46. Bates '625 indicates his battery may be a 1992-sized "microbattery" (Abstract, line 2) or a 1992 "macrobattery" (Column 2, line 34).

30. Bates further characterized his invention as a "lithium microbattery" Column 5, line 26. More specifically at Column 3, lines 2-7, Bates '625 states his invention comprises deposition steps only:

> ...depositing a pair of current collecting films on a substrate; depositing an amorphous cathode layer on the larger of the two collecting films; depositing an amorphous lithium phosphorous oxynitrate electrolyte layer over the cathode; and depositing a metallic anode layer over the electrolyte. (Emphasized).

31. Thus, four depositing steps and no removal steps are taught by Bates as comprising his thin-film battery invention. Microfabrication requires removal of unwanted material. So Bates does not embrace or encompass microfabrication, making it impossible for any Bates battery to be integratable with a MEMS circuit.

32. In respect to the deposition only (no removal) approach of Bates '625, note Column 3, lines 44-48:

> The films may be deposited by fr or dc magnetron sputtering or diode sputtering of vanadium in Aragon, vacuum evaporation or other such film deposition techniques common to the semiconductor electronics industry. (Emphasized).

33. Because of inoperability consideration, Bates provides strict limitations to his invention, i.e. the lithium used for the electrolyte layer must be amorphous not crystalline in order for the level of conductivity to be adequate. Column 4, lines 31-39. Similarly, the cathode must be of amorphous vanadium oxide. Column 3, lines 49-52.

34. In terms of size, the Bates Li-VO_X cell is 8 microns thick and covers an area of 1 square centimeter. Column 3, lines 31-32. The smallest cells made by Bates were 1 cm^2; others were larger.

35. In reference to the Figures of Bates '625, a 1992 semiconductor chip 16 is shown as having been previously made and mounted on a package 12 in Figure 1. Thus, the chip 16 and the Bates battery are not simultaneously formed and, therefore, are not integrated. Adjacent to, but not on, the chip 16 is formed a Li-VO_X battery cell 10, having thickness of 8 microns and a 1 square centimeter area. Because battery cell 10 is not formed at the time the chip is formed, but later, cell 10 is not an internal power source, but an external one requiring connection to the chip 16 using external wire leads 14.

36. Bates mandates the formation, by deposition only, of spaced larger and small vanadium current collectors 18 and 20 on a substrate 22. Figure 2a. Sputtering of vanadium in Argon is suggested. Column 3, lines 45-56. Note that Bates does not teach in any way, shape or form removal or patterning of any part of the layers comprising current collectors 18 and 20.

37. Next, by deposition only, a cathode layer 24 of amorphous vanadium oxide is deposited on part of the exposed surface of larger current collector 18. Figure 2b. This is accomplished by sputtering vanadium in Argon +14% O_2. Column 3, lines 51-52. No part of layer 24 is removed and layer 24 is disposed entirely within the perimeter of current collector 18.

38. An electrolyte layer 26 is then superimposed over the VO_X cathode layer so as to extend beyond the perimeter of both layers 18 and 24, so as to be contiguous with the substrate 22, the current collector 18 and the cathode 24. Figure 2c. Electrolyte layer 26 is composed of amorphous oxynitride lithium is created by sputtering Li_3PO_4, lithium orthophosphide, in 20 milliTorr of N_2 and a total gas flow of 14 sccm. Layer 26 is characterized as being an "vitreous electrolyte film." No part of the sputter deposition layer 26 is removed. Column 3, lines 52-57.

39. A fourth layer is created by deposition of lithium. Specifically anode layer 28 is formed by film deposition of a smaller layer of lithium over electrolyte layer 26. No part of layer 28

is removed. Bates mandates that the anode layer 28 be in contact with both the electrolyte layer 26 and the smaller current collector layer 20. Figure 2d. Column 4, lines 3-8.

40. The foregoing is consistent with Claim 1 of Bates '625 as shown below:

1. A thin-film electrochemical cell [10, Figure 1] comprising:

a) a substrate [22, Figure 2a];

b) a first and a second electrically conductive film [18 and 20, Figure 2a] deposited on the surface of said substrate, said first and second films separated horizontally and said first film larger than said second film;

c) a third film [24, Figure 2b] of electrically conductive material deposited over said first film;

d) a fourth film [26, Figure 2c] of an electrolyte overlapping said third film to extend upon said first film and to partially extend upon said substrate separating said first and second films, said electrolyte having the composition $Li_XPO_yN_Z$ where x has an approximate value of 2.8, 2y=3z has an approximate value of 7.8 and z has a value between 0.16 and 0.46; and

e) a fifth film [28, Figure 2d] of electronically conductive and chemically active material deposited over the remainder of said substrate separating said first and second films and over substantially all of said second and said fourth films, said fifth films being electrochemically stable in contact with said fourth film.

41. Claim 1 of Bates 5,455,126 is more limiting:

1. An electro-optical device comprising:

a) An <u>optically transparent anode</u> of a first electrically conductive material;

b) an <u>optically transparent electrochromic material</u> overlaying said anode;

c) an <u>optically transparent electrolyte</u> containing nitrogen therein overlaying said electrochromic material; and

d) an <u>optically transparent cathode</u> overlaying said electrolyte. (Emphasized.)

42. The Bates process does not and can not make microscopic batteries integratable with MEMS because: (1) the resulting Bates battery is too large; (2) Bates teaches his battery is external to the device being powered requiring wire leads 14; (3) the high temperatures required to create the Bates battery would destroy the MEMS circuit, if made simultaneously, making the MEMS useless; and (4) Bates constraints his batteries to lithium and to a deposition (additive only) thin layer approach and does not teach a battery obtained from patterning from use of microfabrication techniques, among other reasons.

43. Bates does not propose etching or any other form of patterning by which unwanted material is selectively removed. Bates simply creates flat unaltered layers through deposition, by sputtering, for example. To misconstrue Bates otherwise invades in a major way the prohibited realm of hindsight reconstruction and suggests an examination bias.

44. A lack of USPTO battery expertise is indicated by reason of the following clearly erroneous statements, among others:

a. Electrolyte is "reaction accommodating". (The reactions occur at the electrode material/electrolyte interface, or in the interior of the active material, not in the bulk of the electrolyte. The electrolyte merely serves to conduct lithium ions between electrodes, and prevent physical contact between electrodes.)

b. The "batteries can be scaled down for microelectronics applications, a size that frequently is many times larger than the semiconductor chip on which

they are used." (This refers to other lithium battery technologies, i.e. non-rechargeable (primary) lithium button cells sold commercially, to power cameras, watches, and other small electronics. These button cells (~1-2 cm^2 typically) are many times larger than the semiconductor chip. This is what Bates is referring to, rather than the Bates battery.)

c. "Bates also discloses the fabricating technique may include rf or dc magnetron sputtering, or diode sputtering or cold pressing or lithographic techniques...[t]hus, it is noted that any of these fabrication techniques is capable of producing a patterned or designed material by eating into the material surface as required by action or etching. Thus, the electrodes are etched." (This is absolutely absurd.)

45. The Examiner mentions five processes. Rf/dc magnetron sputtering and diode sputtering, are *additive* processes, meaning they are methods of depositing but not removing material. Furthermore, when they are used, they create *global* deposits, which are large in area and not patterned. Microscopic features are not created by Bates because patterning is not taught or used by Bates. Patterning, excluded by Bates, must have a low enough resolution (micrometer range typically) to *selectively* remove unwanted material. Bates only teaches a global additive approach. Bates does not teach the patterning for micro-scale feature size, and does not teach etching at all, and certainly not of micro-scale features. The Examiner is in error to groundlessly read into Bates micro-scale etching. Bates does not disclose any *subtractive* process (one that "eats into material," using the Examiner's language).

46. "Cold-pressing," is done on a pellet used to perform the sputtering. It does not refer to the battery at all.

47. "Lithography," is misused by the Examiner. A careful reading of the text in question (Column 2, Lines 12-19) shows that Bates was using the term to define the size of the Bates battery, i.e. "sizes achievable with present lithographic techniques". Bates does not relate lithographic processes to the making of the Bates battery per se. Bates does not disclose use of lithographic processes to make the Bates battery.

48. The Examiner incorrectly states, "It is also disclosed the use of current collectors as part of the electrode structure. *Thus, the electrode layers are conductive.*" The current collectors are on the back of the electrode active material. Current flow must flow through the active material of the electrode, until it reaches the current collector. Thus, the current collector is connected in series (electrically speaking) to the active material. The active material in the cathode is very poorly conductive. If very thick, the battery would cease to operate effectively. Contrary to the express position of the Examiner, the current collectors 18 and 20 do not make the electrode layers conductive. In fact, the active material of the cathode is very poorly conductive.

49. The Examiner further inaccurately asserts that the battery geometries for microfabricated cells of the present invention, are anticipated by Bates. This is absolutely ludicrous. Bates does not disclose nor envision battery microfabrication per se, and certainly not to create "peg in a block," "wire-in-a-can," or spirally wound cells.

50. Bates provides no enablement as to how one of ordinary skill in the battery art could create a microbattery small enough to be integrated with a MEMS, nor does Bates use microfabrication to remove unwanted material. A battery integratable or integrated with a MEMS is not possible using the Bates technology.

51. While the term "microbattery" is used in a number of diverse ways in the literature, in the context of the present application, "microbattery" is used to mean a very tiny battery, made by microfabrication, so small that it is integrated or integratable with a MEMS circuit. The Bates technology can not be used to do this.

52. The Examiner further states that the battery of Bates "can be fabricated directly onto a semiconductor chip, onto the semiconductor die or onto any portion of the chip carrier. Thus thin batteries stand for flat cells as well as having the battery fabricated onto the semiconductor chip implies having the battery integrated." This statement is not true. The Bates battery is clearly not integrated nor integratable with semiconductor 16.

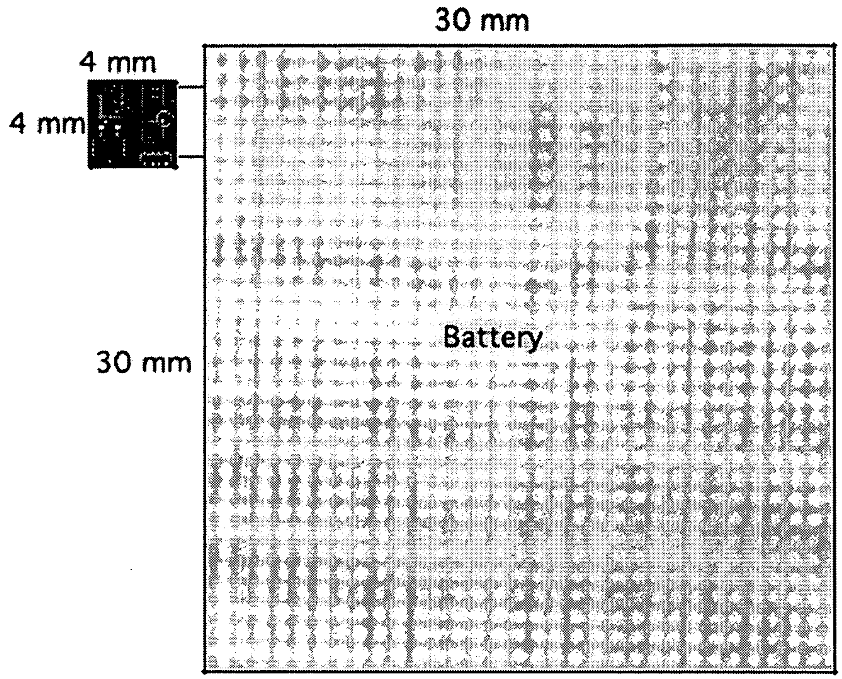
53. There are two primary reasons that the thin-film battery of Bates, and other prior art thin film batteries, cannot be integrated. The first is due to the chemical and thermal conditions necessary to make the batteries.

54. The Bates battery cannot be integrated, as the processing conditions needed for the Bates battery (temperatures > 400°C for extended time) would destroy a microcircuit. The Bates battery must be made separately and used separately as a non-integrated component, that is attached to the circuit with wire leads. As stated by M. Madou, Fundamentals of Microfabrication, 1st Ed., CRC Press, New York, N.Y., p. 442., in reference to the work of Bates,

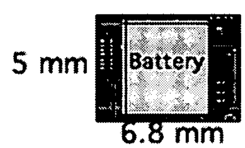
> Often the thin film materials deposited in constructing these batteries, such as Li,TiS_2, V_2O_5, etc,, *prove to be incompatible with the IC process, and the prospect of integrating them with ICs seems remote.* (Italics added). Exh. "L."

55. The second reason that the battery of Bates as well as other thin-film solid state batteries cannot be integrated, is physical (i.e. the relative sizes of the battery and circuit). The Bates battery could conceivably be used to power a MEMS, as a separate large wire connected power source. However, the size of the battery would make this impractical. Figure "a" below shows the

size of a Bates battery that would be needed for a typical MEMS, while Figure "b" shows the size relationship between a battery according to the present invention and a typical MEMS.



a. Accelerometer Circuit with Thin-Film Bates Battery.



b. Accelerometer Circuit Incorporating our Microscopic Battery.

56. As mentioned above, a review of the claims of Bates reveals the Bates invention to be of narrow scope. It is confined to a thin-film solid state battery not capable of being integrated with a microcircuit. The layers are optically transparent, and the solid electrolyte contains nitrogen atoms. The use of LiPON (lithium phosphorus oxynitride) electrolyte, and vanadium oxide with a fine-grain morphology are part of the Bates invention. In practice, the layers of the present invention are, by comparison to Bates much thicker, and, as such, are not optically transparent.

ANALYSIS OF MIEKKA

57. Miekka (U.S. 6,045,942) does not teach patterning, only deposition (with no partial layer removal via etching or in some other way). The disclosure calls for creation of an ultra thin primary battery, but does not characterize the area nor the volume as being small. A large area would be involved in order to produce the energy levels necessary for operative use and to use the disclosed method.

58. In respect to Figure 2, the ultra thin, low profile battery of Miekka comprises "planar" electrodes and is formed using the following steps:

1. A layer of conductive ink 54 is printed, at station 46, on a thin non-conductive polymeric sheet 38 extending and displaced between rollers 36 and 42;
2. A conductive powder 56 is sprinkled by gravity and vibration, at station 48, on the uncured ink layer 54 and, if necessary, pressing the conductive powder into the uncured ink layer 54 using a roller 64;
3. The ink layer 54 with embedded powder 56 is cured, at station 50;
4. Residual loose conductive powder 56 is removed from the top of the cured ink layer 54, presumably using a vacuum at station 52.

The conductive powder 56 is the active electrode material.

59. Aqueous electrolyte is placed in a porous separator disposed between the cathode and anode in any one of several configurations shown in Figures 1 and 3-6.

60. The ultimate area of the thin battery must be quite large because to displace the non-conductive thin polymer film 38 between rollers 36 and 42 would seem to require film 38 to be of substantial width.

61. The "printing" at station 46 appears to be via an ink roller.

62. The anode is preferably zinc and the cathode preferably copper oxide or silver oxide, while the aqueous electrolyte is preferably potassium hydroxide.

63. Miekka discloses a specific process used to make the Miekka thin-film PRIMARY (non-rechargeable) batteries. That process involves the application of a conductive ink (such as in a printer), and then placement of powdered active materials into the (still-wet) ink. Various cell geometries are disclosed, most with an unequal number of cathodes and anodes (for example, one cathode and two dissimilar anodes, so as to be able to deliver two different voltages, depending on which anode is used). Miekka does not cover any other type of battery fabrication process. Miekka does not disclose microfabrication of a battery, because no unwanted material is removed.

64. The Examiner erroneously states, "Miekka et al discloses that the electrolyte solution may be maintained in a sealed container such as a bag or enclosure." Miekka's external electrolyte reservoir is used in conjunction with a thin-film non-micro fabricated primary battery, not a microfabricated battery. Also disclosed is the use of cupric oxide, silver oxide, nickel oxide and zinc. The Miekka thin-film primary battery is not rechargeable and is not microfabricated.

65. The Examiner states, "Miekka et al. envision an electrolyte influent flow path." This is not news in the battery world. Such a concept is the basis for a whole class of batteries known as "reserve batteries," which has existed for decades. Applicants' disclose the use of an electrolyte influent in conjunction with microfabricated batteries which are integratable with a MEMS.

66. The Examiner erroneously asserts that it would have been obvious to anyone skilled in the art to make use of the specific liquid electrolyte material of Miekka (aqueous potassium hydroxide) and flow path "in the thin-film battery of Bates." This is upsettingly off target. Anyone

even modestly skilled in the art of batteries would know that exposure of the electrode materials of Bates to a water, would ruin the Bates cell and render it inactive and perhaps dangerous. Further, the external electrolyte reservoir is only useful for extending the shelf-life of an aqueous battery, and is not needed in the solid-state battery of Bates, which (if properly constructed) is stable for years, even with their electrolyte in the cell.

67. The Examiner incorrectly states that "it would have been obvious to one skilled in the art at the time the invention was made to use the specific electrode material of Miekka et al. in the thin-film battery of Bates et al. as Miekka et al. teaches that it would be readily appreciated that the active material are such materials or combinations thereof which cooperatively participate to produce the desired electrochemical reaction...." On the contrary, anyone with even mediocre of skill in battery art would know that Miekka is referring to aqueous electrolyte batteries, and that the non-aqueous, non-liquid battery of Bates would be destroyed in the presence of water.

68. Furthermore, the electrode active materials of Miekka would only with difficulty be of any use in the battery of Bates. The powders that Miekka uses as active materials could not be used in the process of Bates. Furthermore, they would not "produce the desired electrochemical reaction," as the materials of Bates are "insertion" compounds, such as LiCoO2, LiMn2O4 or LiNiO2. The reaction mechanism is different than the electrode materials used in aqueous batteries, such as mentioned by Miekka. Normal battery materials, such as used in aqueous batteries (lead-acid, nickel-cadmium, etc.) go through chemical reactions during charge and discharge. In other words, the starting materials are converted to a different compound. For example, lead metal in the negative of a lead-acid battery is converted to a lead sulfate on discharge. In a lithium-ion battery, the electrode materials operate on a different principle. Rather than undergoing a chemical reaction and subsequent phase change, the materials retain their same structure when charged and discharged.

During battery operation, lithium ions are inserted or removed from the crystal lattice of the active materials. None of the materials mentioned by Miekka would be suitable electrode materials in a lithium-ion battery, such as Bates. Also, the operating voltages of Miekka would be much lower than the materials used by Bates.

69. The Examiner erroneously states that the battery of Miekka could be made using the Bates process. This is simply untrue. Miekka discloses a very narrow processing approach, using an ink, etc. Use of an aqueous electrolyte is also disclosed. The process of Bates is utterly incompatible with water, In fact, the battery process is performed is a desiccated environment.

70. The Examiner states, "It is also noted that Bates and Miekka are pertinent to each other as well as to the applicant's invention as they both share the same field of endeavor of providing working functional thin-film microsized batteries." Bates and Miekka do not disclose microsized integratable MEMS batteries. Furthermore, it is a non-obvious stretch to assert that Bates and Miekka are pertinent to one another. About the only thing that they have in common are thin-film construction (although Miekka is much thicker than Bates). Other than that, their processes are incompatible. Their chemistries are incompatible. Bates discloses a rechargeable battery; Miekka discloses a primary battery.

MIEKKA AND BATES ARE NOT COMPARABLE NOR COMPATIBLE

71. For the reasons presented immediately above, Miekka and Bates are not compatible and not combinable.

CONCLUSION

72. In summary, the presently pending elected claims are not anticipated or made obvious by Bates alone or together with Miekka because Bates does not teach microfabrication, is comparatively huge prohibiting MEMS integration and Bates and Miekka can not be combined, among other reasons.

73. Until the present invention, no one of ordinary or extraordinary skill recognized, over a period of many, many years during which the need existed that a tiny microscopic battery could be microfabricated so as to be size compatible and integratable with a MEMS or similarly sized microcircuit and still have sufficient electrical power to properly drive the MEMS circuit. Thus, the present discovery, including its methodology, is not anticipated nor obvious to those having skill in the battery field. The present invention, for the first time provides a battery fully integratable with a MEMS or MEMS-sized circuit, a feat never heretofore accomplished, which has great technical and commercial significance.